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George H. Ashley, State Geologist.

RIVER COALS OF EASTERN PENNSYLVANIA

by

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Abstract.

Coal has been reclaimed from the streams leading from the anthracite region for 40 years and has been industrially important for the last 20 years. The size has gradually decreased, until at present, it is almost entirely barley and finer. River coal is largely used in power plants and factories; smaller amounts are used for domestic and metallurgical purposes.

At present the industry is largely in the hands of small operators although a dozen or two operators have fairly large investments, mostly in the vicinity of Harrisburg and on the smaller creeks. The total production is in the neighborhood of 750,000 tons a year.

In the future the size of the coal will continue to decrease and the market will gradually narrow. Thus the production will decline. The very fine sizes will continue to be burned in power plants along the rivers and a few large operators will continue to take out large quantities of extremely fine coal for pulverization during the next 20 years. Eventually, however, the river coal will be a by-product of the sand and gravel industry, although some coal will be dredged as long as anthracite is mined.

Sources of information.

The data in the following report were obtained during the summer of 1930 by visits to the anthracite fields, inspection of the streams flowing therefrom, and by interviews. The engineers, superintendents, and executives of the larger coal companies were interviewed to obtain some idea of the quantity of coal going into the streams. The river coal operators were interviewed to find out the tendency of the river coal in the last few years, the condition of the industry at present, and its probable future. Most of the plants recovering coal from rivers and creeks were visited and the coal examined. Many of the large consumers of river coal were interviewed on the present methods of using it and the probable method and extent of future utilization. The following companies were especially courteous in giving information and, in some cases, analyses of the coal used by them.

Luzerne County Gas and Electric Corporation, Kingston
Magee Carpet Company, Bloomsburg
Metropolitan Edison Company, Reading
Pennsylvania Water and Power Company, Baltimore
Nolde and Horst Co., Reading
Consumer's Gas Co., Reading
Sears, Roebuck and Co., Philadelphia
W. J. McCahan Sugar Refining and Molasses Co., Philadelphia
Pennsylvania Power and Light Company, Allentown
Armstrong Cork Company, Lancaster
New Jersey Zinc Company, Palmerton
Central Iron and Steel Company, Harrisburg
Harrisburg Railways Co., Harrisburg

Special acknowledgement should also be made to Mr. Jonathan P. Edwards of the Jonathan Coal Mining Co., Philadelphia, who gave the writer many suggestions and much information from his wide experience in the river coal industry. Bulletin M 12[illegible] of the Survey has

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[illegible]Sisler, J. D., Fraser, T., and Ashmead, D. C., Anthracite Culm and Silt, Pennsylvania Topo. and Geol. Survey, Bull. M 12, 1928. Obtainable from Bureau of Publications, Commonwealth of Pennsylvania, Harrisburg, Pa. for 10 cents.

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been freely used in the preparation of this report, especially in the part relating to the sources of river coal. The present bulletin supplants No. C of this series "River and Creek Coals in Eastern Pennsylvania" by C. W. Webbert, which was published in January 1920.

Sources of river coal.

The original source of river coal is, obviously, at the mines. The coal which is now being dredged out of the streams is that which has been discarded, voluntarily or involuntarily, by the mine operators for the last hundred years. Each year, however, the mine operators find it more and more necessary to conserve the finer sizes of coal and to make them pay at least part of the cost of mining the larger sizes. Thus, as the mines go deeper and deeper and the cost of mining increases, it becomes imperative to find a market for all the coal, or, failing that, to save as much as possible by settling the fine coal out of the breaker water on silt banks or in settling tanks, in order that at some future time it will be possible to utilize the coal which is not now commercially valuable. Thus, the amount of coal going directly into the streams from the breakers has decreased greatly in the last 25, or even in the last 10 years.

From this, however, it should not be inferred that the quantity of coal going directly from the breakers into the streams is negligible. As nearly as the writer was able to ascertain, no coal of larger size than barley is now going into the streams in appreciable quantities. Considerable quantities of barley and No. 4 buckwheat however, are going into the streams, especially from the smaller collieries.

Breakers: The Northern field probably contributes less river coal to the streams than any of the others, partly because the companies operating in this region are old and well established and take effective measures to prevent the loss of the fine coal, and partly because the coal is less friable than the coal in the fields farther south, thus producing a smaller percentage of fine sizes. Another factor in the reduction of the loss of fine sizes in the Northern field is the fact that the coal lies on fairly flat pitches, so that the very fine coal is not brought to the surface in large quantities and what is brought to the surface is flushed back into the mines for silting, thus eliminating a large source of river coal.

In spite of all these factors working to reduce the quantity of coal going into the streams from the Northern field, still some coal is being lost. Lackawanna River is quite black with suspended matter, but most of this is extremely fine. The only place where any large quantity of coal of usable size was observed in the

stream was opposite the Marvine colliery of the Hudson Coal Company in the northern part of the city of Scranton. Here an accumulation, estimated to contain 45,000 tons of coal, mixed with slate and sand is No. 4 buckwheat and smaller size. Doubtless there are other accumulations of the same nature from other breakers which escaped notice. With all this, one of the river coal operators reports having tested the flow of the Lackawanna with an 18-mesh screen and caught very little material indeed.

On the Susquehanna from the mouth of the Lackawanna to Shickshinny one sees few places where any large quantity of coal is going directly into the river. At the newer collieries, such as the Dorrance colliery of the Lehigh Valley Coal Company where silting is practiced, no water is going directly into the streams and there are no silt or culm banks to wash. However, some of the smaller streams are black with fine material in suspension and a few collieries empty directly into the stream. Of these, the largest amount of material was observed going in from the Nocanaqua colliery of the West End Coal Company opposite the town of Shickshinny, but this, as shown by the delta built up in the stream by the breaker water, does not contain much coal larger than No. 4 buckwheat.

Thus it may be concluded that coal going into the streams directly from breakers in the Northern field is almost all No. 4 buckwheat or finer, the bulk of it being material that will pass through a 50-mesh screen. The total tonnage is probably not large in comparison with 15 or even 10 years ago.

In the Eastern Middle field the percentage of fine coal that goes directly into the stream is even lower than in the Northern field. The quantity of fine sizes produced seems to be somewhat larger than in the Northern field, due to the greater number of steep pitches; but, since the production is almost entirely in the hands of two or three large companies, the finer sizes are conserved rather well. At the office of one of the largest operators it was stated that about one size smaller is being recovered now than was recovered 5 years ago. This means almost all of the No. 4 buckwheat is being recovered. In nearly all of the collieries the breaker water is run onto silt banks. Thus only the very fine material goes into the creeks. There is enough of this, however, to keep the streams quite black. Very few of the large deposits in the stream valleys seem to be recent, however. One may conclude that the present breaker waters of this field contribute but little usable coal to the rivers and creeks.

In the Western Middle field which seems to be the chief source of the river and creek coal at present the situation is different. Most of this coal finds its way to the Susquehanna, via. Shamokin and Mahanoy creeks, but a small portion gets into the Schuylkill.

How much of this coal comes directly from the breakers, and how much is washed from old accumulations is uncertain, but the amount from the former source must be large. The proportion of old style breakers in this field is rather high and the loss of fine sized coal from them into the streams is considerable. This loss is increased by the difficulty of constructing and maintaining good silt banks in

the narrow valleys that characterize the field. Although this loss of coal is probably less than in years past, it will, in all probability decrease sharply in the next few years, due to the erection of very large coal breakers such as the Locust Summit breaker of the P. & R. C. & I. Co., which will handle the output of several collieries, will utilize the fine sizes much more fully, and store the silt more securely.

The quantity of coal coming from breakers is still large, as is shown by the fact that one creek coal operator on Mahanoy Creek near Gordon, who ordinarily takes out from 5 to 6 cars of coal a day ranging from No. 4 buckwheat to pea in size, finds that during a strike or suspension of work at the collieries farther up the creek he is unable to get sufficient coal and must shut down. This shows that the coal moving down the creek, in great part at least, comes directly from the breakers.

On Shamokin Creek the situation is somewhat similar. The operator of one small washery taking out barley coal at Shamokin reports that he gets more coal in the afternoon when the water from the collieries above begins to reach them, indicating that on this creek also a good deal of coal is coming directly from the breakers, and that some of it at least is of barley size or larger.

Thus, we may consider that breaker water in the Western Middle field is one of the major sources of the river coal in the Susquehanna drainage.

In the Southern field the conditions governing the supply of coal from breaker water are almost the same as in the Western Middle field. The valleys are narrow and steep, streams small, and mining is done on pitches even steeper than those of the Western Middle field. Furthermore, squeezing and faulting had so crushed the beds that the percentage of fines is higher. The greater part of this field drains into the Schuylkill. The western end, however, drains into the Susquehanna, through Swatara and Wiconisco creeks, while the eastern tip drains into the Lehigh through Nesquehoning Creek.

Since such a large percentage of fine sizes is produced, and the narrow valleys make the storing of silt difficult, it would be supposed that a large quantity of coal would escape directly into the streams from the breakers. However, as most of the collieries are in the Schuylkill drainage, and this river flows through several cities to the south where river pollution is a sore subject, an effort has been made by the two companies that control most of the collieries in this district to settle their breaker water on silt banks or in settling tanks before turning it into the streams. Unfortunately the breaker water sometimes goes over the bank too fast for proper settling and carries much fine coal, even up to barley in size, into the stream. Settling tanks are somewhat more efficient than the banks, but in this case also, sometimes the tanks fill up, so that the water runs through quickly and hardly settles at all.

It seems that the coal now going into the streams from the breakers rarely exceeds No. 4 buckwheat in size and has steadily diminished in quantity during the last few years. Breaker water is

still, however, a major source of coal for Schuylkill River and supplies most of whatever coal is now going into the Lehigh. The coal now going into Wiconisco and Swatara creeks from breaker water is of minor importance.

The future of this source of material is somewhat hard to determine. There is no doubt that, by proper settling tanks and thickeners, it is physically possible to reduce the solids entering the streams to a small percentage of extremely fine material which would have little value as river coal. In the present state of the anthracite industry, however, the additional cost of caring for all the silt in this manner would probably raise the cost of operation so that the small margin of profit would be wiped out and a good many of the smaller breakers would have to shut down. This cost would be increased also by the necessity of taking care of the water used in cleaning the jigs. Thus, it is not likely that the amount of river coal coming directly from the breakers will be cut off or sharply diminished in the near future unless breakers are shut down in large numbers or great pressure is brought to bear on the coal companies or organizations interested in the prevention of stream pollution.

Culm and silt banks: The next source of river and creek coal is the wash from culm and silt banks. There is some dispute as to the importance of this source. The quantity of culm and silt stored in the anthracite field is enormous. James D. Sisler in 1925 estimated the total culm and silt as 217,750,000 long tons, and even a small proportion of wash from these banks would supply large amounts of material to the streams. Twenty to 80 per cent of the material in these banks is coal and probably at least 50 to 75 per cent of the coal is No. 4 buckwheat and smaller.

In the Northern field the accumulation of culm and silt is comparatively small, being only about one-twelfth of the total in 1925, and has probably been somewhat reduced since then by washing and loading although such operations do not seem to have been very extensive in the last five years. Since this valley is quite broad, most of the banks are away from the streams, and there is little wash.

In addition most of the culm banks in this valley that contained much good large coal have been washed out and loaded, and the ones that remain are either very fine or high in slate or ashes. The silt banks are also reduced by the common practice of mine silting or using fines for generating power. Thus little coal of usable, or of any size, comes from the banks of this field.

In the Eastern Middle field the banks are rather small and in most cases are quite well protected. However, there is some wash, and the streams are quite black. The culm and silt of this field in 1925 was only 5 per cent of the total and the silt accumulation was nearly three times that of the culm. Thus, it would be expected that the wash from the banks would be very fine as well as relatively small in quantity, and an examination of the streams seems to bear this out. At some places in the streams, nevertheless, are accumulations of fairly fresh-looking, rather coarse material that may be from breakers or from silt banks. Black Creek which drains into the

Lehigh east of Weatherly is the only notable source of river coal in this field. This creek takes the drainage from 8 collieries and a number of banks. It is quite black and carries a good deal of silt to the Lehigh, being one of the main sources of the coal in the river. Another Black Creek, draining west into the Catawissa and Susquehanna, carries more coal, but little of this seems to be derived from banks as they are mostly well protected.

As a whole the banks of the Eastern Middle field are not an important source of river coal except for the Lehigh.

In the Western Middle field the banks are much larger than in any of the other fields, due in large part to the character of the coal and the difficulties in mining. The loss of commercial sizes in preparation is estimated at between 5 and 6 per cent of the coal mined, of which about three-fourths goes on the banks. In 1925, Mr. Sisler estimated that 101,695,000 long tons of culm and silt was stored in the banks of this field. Some of this has been washed out in the last few years, and a good deal loaded and shipped, but there is probably at least 100,000,000 long tons left.

Storage space for silt and culm is at a premium in the narrow valleys in which this coal is mined, and the banks must be piled very close to streams and be made very steep, thus facilitating the washing of the coal into the creeks by heavy rains and floods. Shamokin and Mahanoy creeks for a great portion of their courses through the coal region, flow at the base of culm and silt banks from 50 to 150 feet high. Floods wash thousands of tons of coal into these streams. Much of this coal is of good size with a high percentage of rice and barley in it. In the older silt and culm banks are gullies which have been cut by heavy rains. The newer banks are usually fairly well protected by rock, but even some of them wash in flood times. Thus, the silt and culm banks of the Western Middle field seem to be one of the major sources of creek coal and, through Shamokin and Mahanoy creeks, a major source of the coal going into the Susquehanna.

In the Southern field conditions are somewhat like those in the Western Middle field. Although the average proportion of fine sizes is around 5 per cent of total mined at some of the collieries in the badly crushed and folded coal along Sharp Mountain, the loss in sizes too fine to use runs as high as 10 per cent. In spite of the quantity of fines produced in this field, it is doubtful whether the coal entering the streams at all approaches the amount coming from the banks of the Western Middle field. The total tonnage of culm and silt in the Southern field as estimated by Mr. Sisler in 1925 was 88,085,000 and it is probable that this tonnage has not materially changed since.

In places this material is piled steeply, and washes as badly, as the banks along Shamokin and Mahanoy creeks, but in general the valleys are wider and the banks are spread over more territory and so are less subject to washing. Where the banks are steep they are usually well protected with rock. Near St. Clair and at the headwaters of Swatara Creek are some old silt banks which wash rather badly. The material from these banks is quite fine. There are numerous old culm banks of good coarse coal in the valley from Pottsville to Lansford but most of them are grown over and but slightly

eroded. A washery working in a old bank of the Lehigh Navigation Coal Company near New Philadelphia is letting a good deal of fine coal go into the stream but very little of this is above No. 4 buckwheat in size.

Most of the coal washed from the banks of this area goes into the Schuylkill. Some of the field drains into Wiconisco Creek, but this is a relatively small area. A few very large and rather coarse banks are washing into the Swatara between Goodspring and Tremont, and there is one washery working on a bank in this vicinity. This all supplies a fair quantity of good coal to the Swatara. The extreme eastern tip of the Southern field drains into the Lehigh through Nesquehoning Creek which is the chief source of coal for Lehigh River. At Nesquehoning colliery, the only one on the stream, a large bank is washing badly, but this is being surrounded by a rock bank as fast as the rock is taken out of the mine.

Thus, while the silt and culm of the Southern field is more important as a source of river coal than that of either the Northern or Eastern Middle fields, it is somewhat less important than that of the Western Middle field.

We may expect that in the future there will be no sharp diminution in the quantity of material washing from silt and culm banks, but that the quantity will gradually decline as the old banks are washed away and the never are protected with rock. If the silt and culm banks are washed out and loaded in response to some great demand for coal, the source of this material will be cut off and the decline in quantity will be faster; but, in the present state of the anthracite market, it is doubtful if the next 10 years will show much decline in the material washing from the banks into the stream.

Stream channels: Even if the supply of coal coming into the creeks from the breakers and culm and silt banks were to be entirely cut off, the supply accumulated in the bottoms, banks, and alluvial flats of streams leading from the anthracite regions would be large enough so that coal in commercial, though diminished, quantities could be taken from the streams for perhaps 7 or 8 years. Thus, this source must not be overlooked in any study of river coal.

The amount of coal in the bottom of the rivers and creeks is almost impossible to estimate, but it must be very large. In the northern part of the city of Scranton, the Lackawanna River shows large amounts of fine coal deposited along the banks; and, doubtless, there is much more in the river bottom. Slate is abundant here, however, and the material is quite fine. At Kingston, across the river from Wilkes Barre, the dredging of river gravel for a fill has brought up much coal of about No. 4 buckwheat size and about 5 per cent of domestic sizes. It is said, however, that this coal is for most part washed later into the holes made by the dredge and is not the material originally on the bottom.

From Wilkes Barre down the Susquehanna, coal is found in bars and pockets as far as the Maryland line. It shifts and moves so rapidly that no estimate can be made of the quantity in the river at any one time, but it is probably something over 500,000 tons. The amount on the bottom at any one time in a given area is relatively

constant: for when the holes or riffles that ordinarily hold the coal are filled, the rest of the coal fills holes farther down the river. As one of the [illegible] put it, the river bottom is like a [illegible] which, when full, lets any additional material slide off the top. This [illegible] is full the rest of the coal goes on down stream, [illegible] digs out some of the coal the hole fills up, providing there is enough water to carry the coal.

The estimate in the preceding paragraph only applies to coal of 1/16th [illegible]. The quantity of smaller coal, most of which [illegible] for pulverization, is much larger. A survey made by the Pennsylvania Water and Power Company of the coal for a mile and a quarter above the Holtwood dam showed that [illegible],000 tons of coal are deposited there, over half of which passes through a 30-mesh screen. There must be 8 to 10 million tons of coal of this size in the river and more coming in all the time, for, as has been shown, the collieries are making practically no effort to recover coal of the very smallest size.

The quantity of coal in the bottom of the creeks tributary to the Susquehanna is problematical, but it must be well over 1,000,000 tons, three-fourths of which is in Swatara, Mahanoy and Shamokin creeks. Most of this [illegible] be very good coal and, in the case of Swatara Creek, is the accumulation of the last 40 or 50 years.

The quantity in the bottom of Lehigh River is even harder to estimate as it is caught behind dams, and the dams are being constantly pumped out, but it probably is about [illegible]00,000 tons at one time.

The situation in the Schuylkill is a good deal the same as on Shamokin and Mahanoy creeks, although pumping in the Schuylkill has been so active that the coal in the bottom will not exceed [illegible]00,000 tons at any one time.

The purity of the coal in the bottom of the stream varies according to the place and time of year, but in general the amount of slate and bone in the coal decreases with the distance from the mines. From Sunbury on down the Susquehanna, little slate is found; from Sunbury up to the Northern Field, the lower part of the coal bars contains an increasing amount of bone and slate. The sand and gravel mixed with the coal increase down river, but a separation is easily made.

In the extremely fine sizes there is much slate and bone and the ash content (aside from sand) runs 20 to 30 per cent. It is almost impossible to separate out the slate and bone in sizes that pass through a [illegible]-mesh screen, but, since these sizes are almost exclusively used for pulverization, the slightly higher ash content is of no great importance.

On the creeks slate is found near the mines but is negligible a few miles down stream. At Schuylkill Haven on the Schuylkill River in high water there is some slate, but at Reading it is found very rarely. On the Lehigh the gradation is less marked, but there is considerably more bone, rock and coarse coal in the dam above Mauch Chunk, than 20 miles down stream in the dam below Treichlers.

Cinders and boiler ashes in the river bottoms are more troublesome than slate, bone and sand. These are almost impossible to separate because they have nearly the same specific gravity as the coal. None of the ordinary devices for separating out the heavy impurities will take out fine sized ash and cinder. Fortunately, the cinders are usually larger than the coal and a large proportion of them may be screened out. Ashes are most troublesome just above Bloomsburg on the North Branch of the Susquehanna, where they probably come from Hunlock's Creek and West Pittston power plants, and just above Marietta, where they probably come from the power plants in the vicinity of Harrisburg and from the river dredges.

Flood plains: Besides coal in the channels, there is an enormous amount stored in flood plains and banks of streams. This is gradually washing away as the streams are relieved of their burden from the breakers and start to cut into these old deposits.

In the Northern field, along the smaller creeks and Lackawanna River, considerable coal of very fine size has accumulated, but there are no extremely large accumulations, and during high water most of the smaller ones are washed away. There are no large flood planes composed of coal silt.

In the Eastern Middle field considerable silt has accumulated in one or two great flats. The most notable of these is in the valley of Beaver Creek at the town of Beaver Meadows 5 miles southeast of Hazleton. This deposit was many years in accumulating from the discharge of a half dozen collieries in the days before any attempt was made to settle the breaker water. It is about 25 feet deep and must contain several million tons. The stream is now cutting into this accumulation and carrying it down into the Lehigh. An attempt was made some years ago to wash and ship this silt, but it was abandoned because of the high proportion of ash and slate in the coal. There is much good coal of commercial size in this flat and by the sorting action of the stream much of it will become available as river coal. Another very notable accumulation is in Black Creek in the vicinity of Jeddo and Ebervale, but that is in a swamp and does not seem to be washing away.

Aside from these large accumulations there are many small ones along the banks of Hazle and Black creeks (the one draining west) that are washing downstream. Thus, the Eastern Middle field is rather important as a source of coal coming from alluvial flats.

In the Western Middle field, as might be expected, the accumulation in flats and along banks of streams is enormous. Mahanoy Creek, from Mahanoy City to Mahanoy Plane, flows through a continuous silt accumulation that is about 40 feet thick and contains many million tons. This is the largest silt accumulation in the anthracite region. At present these deposits are not being rapidly eroded; they contain much good coal and must be regarded as a potential source of river coal of the greatest importance. At Girardville, at the junction of Shenandoah and Mahanoy creeks, there is another large deposit which seems to be washing downstream to a greater or less extent. Shenandoah Creek also flows through great silt deposits which are going downstream in sizeable quantities. Mahanoy Creek is lined with flats of silt as far as Barry Station below Gordon. The silt stored in flats and along the banks of Mahanoy Creek must total tens

of millions of tons and most of this will eventually work downstream into the Susquehanna.

Shamokin Creek is in a similar condition, although the quantity of material stored along this creek is not as great. The accumulation in the flood plain just west of Mt. Carmel is notable as it covers nearly a square mile and is probably at least 30 feet deep; it contains a large proportion of usable coal. This silt, accumulated before the collieries settled out the fine coal, is now washing downstream. Several washeries working here have helped to reduce the amount of silt. From Mt. Carmel to Shamokin the valley is quite narrow and the accumulation of silt is not large until just above Shamokin where the valley widens. From there to Arters station the flood plain contains many millions of tons. One operator of a dredging plant at Dalmers estimates that one island near there contains a million tons of silt of which 50 to 75 per cent is usable coal.

In brief, the flood plains and banks of streams in, and leading from, the Western Middle field contain tens of millions of tons of usable coal. Enough of this material is washed downstream to make it one of the most important sources of river and creek coal. Slate and cinders are mixed with the coal, but the quantity of cinder is small and the action of the stream will clean the slate out.

In the Southern field there are no very large accumulations of silt in the flood plains or along the banks, although comparatively small deposits at numerous places make the aggregate rather large.

Nesquehoning Creek has deposited several thousand tons of material in its flood plain below Nesquehoning. This material contains large proportion of slate, but the stream, having been relieved of a good deal of silt coming from the breakers, is cutting into this deposit and carrying it into the Lehigh, and will sort the slate out.

The Schuylkill drainage has considerable silt deposits in various places, but none so large as those at Beaver Meadow or Mahanoy City. The most conspicuous deposits are just below Coaldale on Panther Creek and along the Schuylkill from Middleport to Pottsville. In the vicinity of St. Clair is a fairly large flood plain of silt, but its depth is not known. On the west branch of the Schuylkill the largest silt deposits are at Minersville and Llewellyn and those are only moderate in size. However, there are small banks of very fine material all along the banks of the streams. The main Schuylkill River has a large quantity of very fine coal on its banks and in small flood plains as far as Reading, but most of this is so fine that it must be classified as muck.

The Swatara has much coarse good coal along its banks almost to Hummelstown, but no great accumulation at any one point.

Wiconisco Creek receives the drainage from only three collieries and the deposits along its banks, being not very large are relatively unimportant. There is some accumulation of silt just above Lykens.

From this data we must conclude that the silt along the banks and in the flood plains of the streams in, and leading from, the

Southern field is only a moderately important source of river coal. As a matter of fact, Mr. W. H. Dechant of Reading, who made a report on the pollution of the Schuylkill River for the Reading Chamber of Commerce, estimated that if the source of material from breakers and silt and culm banks were removed, the river could be cleaned in 5 years and the usable coal would be taken out in less than half that time.

To sum up the source of the coal now being dredged from the creeks and rivers, the most important source of material is Shamokin and Mahanoy creeks carrying large amounts of material directly from the breakers, and also wash from the silt and culm banks and flood plains of the Western Middle field. These two creeks supply, and have supplied for a good many years, not only coal for the washeries along their banks but also a good part of the coal which is taken out of the Susquehanna from Sunbury to Pequea. The creeks and rivers of the Northern field are important as the chief source of the coal dredged in the North Branch of the Susquehanna. The Quantity of coal washed down from the Northern field is comparatively small and will in all probability get smaller in size and quantity from year to year. The Eastern Middle field is important only because Black Creek supplies a large part of the material that is now going into the Lehigh, and Catawissa Creek brings a good deal of material into North Branch. The Southern field is important and the source of the material in the Schuylkill and, through Nesquehoning Creek, is one of the major sources of the coal in the Lehigh. The Wiconisco is of relatively minor importance, while the coal on the Swatara seems to be confined largely to what has been in the stream for quite a while and is of better quality.

It seems inevitable that as years go on these sources of river coal will gradually diminish as the quantity of coal lost from breakers declines, as silt and culm banks are better protected and are washed and loaded, and as the production of anthracite declines. It is notable, however, that the supply from the Western Middle field, especially the coal derived from the washing downstream of silt and culm banks of flood plain deposits, will continue for years after the coal coming from other field has declined to the vanishing point.

Rate of movement.

The rate of movement of coal downstream measures the time that it takes a change of diminution of the source to affect the dredging farther down the river. Fine sizes in the smaller and swifter streams travel very fast. A washery working near Shamokin was reported to find the coal best about an hour after the collieries had shut down for the night and had cleaned their jigs, showing that the coal from the jigs took only an hour or so to come from the collieries 1 to 5 miles distant. Another washery at Shamokin reports a lag of 3 to 4 hours between the starting of the breakers and the time when the coal reaches the washery. At this rate the coal ought to reach the mouth of the creeks in a few days. On the river, however, the movement is very much slower. One river operator reported once having observed a bar of coal that moved the 25 miles from Clarks Ferry to Highspire in 2 years with moderately high water. Of course the rate of movement is governed largely by water conditions

and by the size of the material. Thus, the coal moves fastest in spring floods and scarcely at all in the summer low water. Ice gorges also help to disturb the coal and bring it down the river. The fine material naturally moves fastest.

The swiftness with which fine coal moves downstream is shown by the fact that since the erection of the dam at Holtwood an average of 150,000 tons per year of silt has accumulated. Over half of this silt will pass through a 30-mesh screen and probably fully as much has gone over the dam in floods and in gorges as have remained behind.

In 1925 Mr. Sisler estimated that coal approximating No. 4 buckwheat in size took 20 to 25 years to come from the Lykens Valley and 30 to 40 years to come from the Shamokin Valley to Harrisburg. This seems rather slow to the present writer, but he has no data on which a more accurate estimate might be made, other than the few indications that have been given above. Mr. Sisler's estimate was based on a bar of coal about No. 4 buckwheat in size which moved 3 miles in one year. Material of dust or mush size such as the Holtwood coal moves very fast and probably will come down from the mines to Harrisburg in one year or less.

Rate of removal.

The rate of removal of the coal from streams varies much from year to year. The quantity removed since dredging began in 1889 is approximately 13,000,000 tons. The actual quantity may somewhat exceed this figure because statistics have been available for only a little over 40 years. The production for the last 10 years accounts for nearly half of the total.

The greatest coal output was in 1919 when 1,935,000 tons were taken out in response to the demand created by the coal strike and the post-war boom. In the next 2 years the production declined sharply, then went up and now has settled down to about 750,000 tons a year. There seems to be a definite relation between the quantity of coal in the river and the amount of dredging done. Since most of the coal is brought down in the spring, what that is dredged out the operators in the Susquehanna River at least must close down for the summer and wait for the rising water in the fall to bring down more coal. Of late years on the Susquehanna from Bloomsburg to Harrisburg the number of dredges has increased greatly and the coal is taken out faster. In consequence, the period of dredging in the spring and early summer has been shortened, until now most of the coal is taken out in 6 weeks or 2 months. By the middle of July most of the dredges are idle, and those that are working are getting very fine-size coal. In 1930 the slack period was very marked because of the very low water which made it impossible to float the flatboats even if the coal could be found. On the Schuylkill, this midsummer shutdown is even more marked, because on that stream almost all the plants are stationary and unable to move around to hunt for the bars but must shut down when the river ceases to bring the coal. Shamokin and Mahanoy creeks are the only streams on which it seems to be possible to work profitably throughout the summer, and even on these creeks a good many outfits, when visited in the summer of 1930, were nearly

shut down because of the abnormally low water. The summer shortage seems to be coming more acute and is probably due to the decrease in quantity of coal going into the streams as well as to the increasing number of dredges.

Size.

The size of the coal is rather important as it is one of the major factors in determining where and how the coal can be used, if at all. That the coal is getting finer from year to year seems rather obvious. Twenty years ago almost all the coal dredged from the rivers was buckwheat and larger, with some nut and stove coal. In recent years the size of the coal has fallen off rapidly and now the bulk of the coal dredged from the rivers and creeks is barley and No. 4 buckwheat.

At a few places along the Susquehanna coal is dredged for the domestic sizes alone, especially near Danville and Sunbury. Most of the operators along the North Branch screen out the domestic sizes over a 5-mesh or 3/8-inch screen and sell this locally for from $ 2.00 to $ 3.00 a ton at the boats. The output of domestic sizes is small, probably 2 or 3 per cent of the coal dug by these operators. The diggers used for domestic coal only are of the bucket type and have a capacity of 5 to 10 tons a day. Some coal is also dug in shallow water with hand sieves, a long handled shovel with a perforated bottom It is reported that on the North Branch between Bloomsburg and Sunbury a man can earn as much as $ 6.00 a day digging coal by hand.

On the Schuylkill about half of the operators save their domestic sizes and sell them for $ 2.00 to $ 3.00 a ton. They get only 2 or 3 per cent of these sizes, including much foreign matter. For many years almost no coal of this size has been going into the stream so the quantity recovered is rapidly diminishing and is now of no great importance. The total production of domestic sizes does not exceed 7,000 to 8,000 tons a year of which about 1,500 tons is produced on the Schuylkill and 5,000 to 6,000 on the Susquehanna.

The size of river coal most in demand at present is barley, that is, the coal which passes over a 3/32 round hole screen and through a $\frac{1}{4}$ inch screen. This is nearly the smallest size that can be burned efficiently in the traveling grate stokers without special equipment, and this size can be used by a great many of the large industrial plants and power companies located within shipping distance of the dredging operations. The next size smaller is No. 4 buckwheat, which is the coal that will pass over a 3/64 inch screen. This has been rather valueless in the past but is now being used by the power companies burning pulverized coal. The coal that passes through a 3/64 inch screen is generally discarded although near Harrisburg some of the operators dredging for the power companies use 1/32 inch screens. At some future time the development of cleaning and pulverizing apparatus may make even the muck valuable, but at present the difficulty of cleaning prevents the fine coal dust from having ready sale.

Susquehanna River: On Susquehanna River the size of the coal, as would be expected, decreased from Wilkes Barre to Peavea. The average percentage of barley or larger size in the river coal supplied to the Lykens Valley Coal & Electric Corporation from a river coal operation near Plymouth for the last 5 years was 67.2 of the total, while a typical analysis of coal dredged in the vicinity of Bloomsburg and in February 1930 furnished to Magee Carpet Company, shows only 37.8 per cent of barley or larger, exhibit rapid diminution in a little over 40 miles. This diminution may be more apparent than real, however, as the Bloomsburg coal in February may have been considerably under the average.

The next analysis available, of coal dredged on the North Branch just above Sunbury and supplied to the South Milton station of the Pennsylvania Power and Light Co., shows an average of 41 per cent barley or larger during 1929. Analyses of coal dredged from three other places in the vicinity of Sunbury show a fairly good agreement with this, ranging from 38.9 to 53 per cent barley or larger. The fineness of the coal in the Bloomsburg analysis may be accounted for by the fact that during 1928 the coal seems to have been quite fine. One analysis furnished by the Pennsylvania Power & Light Co., of coal from the vicinity of Sunbury dredged during 1928 shows only 31.9 per cent barley or larger, while coal dredged from the same place during 1929 shows 42.7 per cent barley or larger.

The next screen analyses available, also furnished by the Pennsylvania Power & Light Co., are of coal dredged from Susquehanna River between Clarks Ferry and White House. These show a very marked diminution in size of the coal. The 1929 average was only 8.8 per cent barley and larger, while 87.5 per cent passed through a 1/16 inch screen. The 1930 average shows a rather close agreement with this.

Analyses of coal dredged about 55 miles farther down the river at Safe Harbor and Pequea show a further diminution in size. The coal dredged in this vicinity and furnished to the Holtwood station of the Pennsylvania Water & Power Co. in 1928 shows 70 to 80 per cent passing through a 1/16 inch screen, while the 1929 average is from 80 to 85 per cent through a 1/16 inch screen.

Partial screen analyses of coal furnished to the Armstrong Cork Co. in 1929 and 1930 agree well with the above results as far as the coal from the vicinity of Sunbury is concerned, but show such a small proportion of coal smaller than 1/16 inch from Marietta and Pequea that in face of the complete and detailed analyses made of the coal a few miles further down the river by the Pennsylvania Water & Power Co. showing an extremely large percentage (96.3 for the coal behind Holtwood dam) passing through a 20-mesh screen, it is concluded that the coal shipped to Lancaster by the dredgers of the lower river must be a very small portion of the total pumped, the cream as it were.

Thus the river coal on the Susquehanna shows regular decrease in size down river from the Northern field. It is interesting to note that if the size of the coal from each dredging center is averaged and corrected for difference in years and unusual analysis, and the result plotted, with percentage of coal passing over a 3/32

inch screen as the abscissa and the number of miles from Wilkes Barre as the ordinate, it is found that a very regular, almost parabolic, curve can be drawn through these points. This would seem to show that the coal coming into the river from the Western Middle field does not have as great an effect on the size as would be expected from the quantity of coal coming down Shamokin and Mahanoy creeks. Perhaps the large number of washeries on these creeks which take out the larger sizes in great quantities will account, at least partly, for this seeming anomaly.

As might be expected the creek coal is considerably less uniform than the river coal because there is not so much opportunity for sorting by the stream. Thus more sizing is needed in the preparation and the percentage of coal that passes through 1/16 inch screen varies from 10 to 70 in coal dredged from Shamokin, Mahanoy and Swatara creeks according to the size screen used. The barley coal from these creeks goes to Philadelphia and Lancaster, and the finer material goes to the near by power plants. This makes the analyses from any one of these sources deceiving, and only by considering two sets of analyses can a clear idea of the character of the coal be gained. By combining analyses of the coal from Shamokin and Mahanoy creeks furnished to the South Milton plant of the Pennsylvania Power & Light Co. and the Armstrong Cork Co. at Lancaster during 1928 and 1929, 34.9 per cent is obtained as the proportion of the coal passing through a 1/16 inch screen. This figure agrees rather well with that of 35.1 per cent which is the proportion of 1930 Swatara Creek coal passing through a 1/16 inch screen. Farther up Swatara Creek the coal may be coarser, as the coal from Trout Run has the unusually low porportion of 10 per cent passing through a 1/16 inch screen, although this may only be the result of more careful sizing than is practised farther downstream.

Schuylkill River. The coal from Schuylkill River seems to be about the same size as that from the Susquehanna at Harrisburg. An exact comparison is made rather difficult by the fact that in the Schuylkill plants the coal is separated into barley and No. 4 buckwheat grades in contrast with the lumping together of all the coal taken out by the river dredges at Harrisburg. From visits to the plants it seems that coal of No. 4 size is at least twice as abundant as the barley coal. By averaging the analyses of barley and No. 4 buckwheat river coal furnished to the Pine Grove station of the Pennsylvania Power & Light Co. from the Schuylkill River in the last three years and by weighing average of the No. 4 on the basis of two to one, a result is obtained which seems to show that in an average mixed sample of this coal something in the neighborhood of 65 per cent will pass through a 1/16 inch mesh. This is about the same size as the unscreened Susquehanna coal. Schuylkill River coal is a good deal finer than that of Shamokin and Mahanoy creeks, even if allowance is made for the large quantity of coal of No. 4 and smaller sizes returned to these creeks by the washeries.

It is interesting to note that on the Schuylkill as well as on the Susquehanna there is an increasing fineness of the coal down stream.

Lehigh River. As considerably less information is available as to the size of the river coal from the Lehigh than from any other

river, it is somewhat harder to draw any detailed conclusions. Average analyses for 1921, 1925, and 1929 show 19.5, 17.6, and 26.9 per cent respectively passing through a 1/16 inch mesh. This is very good barley size river coal and of better quality than all but the very carefully sized coal from other streams. The fact that the river coal operators do not seem to have much trouble in getting sufficient coal of this size would show that the coal in the Lehigh averages somewhat coarser than the coal elsewhere, except possibly in parts of Swatara Creek. The rapid decrease in size in the last five years indicates that there is not much more barley coal going into the stream and the continued coarseness of the coal depends on the rapidity with which it is mined out.

The tendency of the river coal to get finer from year to year is not shown clearly except in the case of the Lehigh coal which has been discussed above. The specifications that the river coal has to meet remain the same from year to year for long periods, and thus the increasing fineness is not usually shown by the customer's analyses over a period of a few years. A few minutes talk with almost any of the river coal operators, however, will reveal the increasing difficulty of getting coal to fill the size specifications, although this tendency is not so obvious over less than 10-year periods.

Quality.

The intrinsic quality of the river coal is almost the same as that of fresh mined coal from the same fields. Analyses of river coal from Plymouth over 5 years average 5.08 per cent volatile matter on a dry basis while analyses of river coal from the vicinity of Harrisburg, after large quantities of coal from the Western Middle and Southern fields have been added, show an average of volatile matter for the last 2 years of 7.9 per cent. In the Anthracite Culm and Silt, Bulletin M 12, Pennsylvania Geological Survey, it is stated that the analysis of fine coal by ordinary method gives abnormally high results for the volatile matter, due to water of hydration combined with the coal. Thus, the abnormally high second result may be due to this cause, especially as the coal analyzed in the second case was much finer in size than the Plymouth coal. This result is corroborated by the fact that analyses of the coal at Holtwood, over half of which passes through a 50-mesh screen, show a volatile content of 11 or 12 per cent on a dry basis when the ash is reduced to a proportion comparable to that of the other analyses. The exact relationships of the quality of river coal from various localities must remain a little uncertain until analyses are made which eliminate the possible effect of water of hydration on the amount of volatile matter. The indications are, however, that the coal of the Susquehanna River is quite uniform in intrinsic quality.

The coal of the Schuylkill River runs a good deal higher in fuel ratio, as would be expected from the character of the coal in the Schuylkill drainage. Proximate analyses are not available for the Lehigh coal, but it seems to resemble the Schuylkill coal rather closely.

As a whole the fuel ratio of river coal is rather uniform. One combustion engineer burning it remarked that the b.t.u. per pound of river coal varied inversely as the percentage of ash. Generally, except for ash content, river coal compares favorably with fresh mined coal of the same size.

Complete analyses of river coal from selected localities would be interesting and would perhaps throw light on the distinct superiority which river coal has in the recarbonization of steel. They might also lead to the selection of coals from certain localities for this purpose. As a highly speculative guess it might be hazarded that the oxidation of the sulphur in the coal by the action of the water may partly account for this, but nothing definite has yet been determined on this point.

The ash content of the river coal is almost entirely a matter of cleaning and selection of the material dredged. As found in the streams the material varies from almost pure coal to sand with a small amount of coal in it. Slate is present near the mines and ashes and cinders may be found almost any place but are seldom present over large areas. The proportion of coal in the stream beds varies from year to year according to the water conditions. On the Susquehanna, and other streams where barges are used, the highest proportion of coal is found during years in which a large spring freshet is succeeded by a period of fairly low water. High water will bring down large quantities of coal, but it also brings down large quantities of sand well mixed with the coal; the low water is needed to gently sort out the lighter coal from the heavy sand and concentrate it in bars. On the streams where stationary outfits are used high water is necessary to bring the coal past the plant and the operator must be prepared to reduce the ash to marketable proportions by artificial means. The lower limit of ash content is fixed not only by the intrinsic ash of the coal but also by the cost of cleaning. At present the ash content of the various river and creek coals ranges from 12 to 30 per cent. The average is probably something below 20. Probably competition and improvement in machinery in the next few years will bring the ash content down to between 12 and 15 per cent but it is doubtful if the average will ever go any lower except in coal specially cleaned for metallurgical purposes.

Methods of recovery.

Floating dredges. There are various methods of dredging and preparing river coal. The method used depends on the size of the stream and on the size and quality of coal desired. The oldest, as well as perhaps the best known, method is to dig the coal by means of a rotary pump placed on a flatboat, powered either by a stream or gasoline engine. From the pump the coal runs over screens onto barges. The barges are then taken to shore either by poling or with a stern wheel tug, and there unloaded at a permanent or temporary landing. This is the general method used on the Susquehanna and Lehigh and on some parts of the Schuylkill and Swatara.

On the upper Susquehanna, most of the coal, as it is pumped from the river, flows over a simple screen of the size desired and

falls onto barges which are taken to shore and unloaded by scraper line onto the storage pile or trucks without any further treatment. This coal will run from 15 to 30 per cent or more of ash depending on the care used in pumping, as any large pebbles pumped up do not drain out with the sand but remain in the coal. Most outfits make the coal into two sizes by screens on the diggers, the sizes going on different barges. One operator at Plymouth makes five sizes in a plant on shore.

From Danville on down the river, many operators find this simple screening not sufficient to make the coal as clean as their customers desire and so have adopted other devices. Several rewash the coal after it is unloaded from the barges; others are using floating screens, i.e., screens laid on top of galvanized troughs with perforated riffles which create pools in which the sand sinks and then drains out through perforations. Two operators, one at Danville and one at Klines Grove, have installed Deister-Overstrom concentrating tables at their unloading plants, but the relatively small capacity (10 tons per hour) of these tables, together with their cost, prevents their wider adoption on the river in spite of their recognized efficiency in eliminating the sand and gravel. The coal produced by these improved methods of cleaning ranges from 14 to 24 per cent ash and is more often below 20.

Many of the smaller operators from Port Treverton to Bloomsburg use endless chain bucket diggers instead of pumps on their dredges. They claim that, although their output is not large, with these machines they can skim the top of the coal bars and get only the cleaner and larger coal and thus eliminate rewashing or screening, and have a coarser and better product.

Except for one small operation at Liverpool, coal is not dredged between Port Treverton and Clarks Ferry. Between Clarks Ferry and Middletown there are 100 dredges almost all of which use rotary pumps and wash the coal on floating screens, sometimes 20 feet long. The dredges working at Marietta, Cly, and Pequea employ the same method, but one operator at Columbia finds it necessary to use a concentrating table to clean his coal. The floating screen method of preparation produced coal of 11 to 28 per cent ash, although most of it will average 15 to 16 per cent. Here again, a good deal depends on the care with which the pump operators select the location from which to dig. Most of the unloading plants on the lower river use a clam shell bucket and load the coal into a pocket, from which it is discharged to railroad car or truck.

On Lehigh River the method of reclaiming the coal is almost the same as that on the upper Susquehanna. Both chain buckets and pumps are used and the coal, after being washed on a screen on the digger, is loaded in boats and taken on the canal by a stern wheel tug to Palmerton where the New Jersey Zinc Company uses all the coal produced on this river. Only barley and rice sizes are taken out, the quantity of domestic sizes being too small to repay the trouble of saving them. All this coal is dredged behind the canal dams where there is always plenty of water. One outfit at Mauch Chunk in the Packer dam is obliged to ship to Palmerton by railroad as the lower dam at Mauch Chunk is broken and the canal there is dry. As the

Packer dam is the first one on the river the pebbles sink here while the fine coal goes on downstream. The coal above this dam is cleaned on a concentrating table because the percentage of pebbles is high.

On the lower part of the Schuylkill and Swatara, near Reading and Hummelstown respectively, the coal is also dredged or pumped and boated to shore. The boats are quite small and a good deal of the preparation is done on shore by rewashing and tabling.

Stationary plants. The other important method of reclaiming river or creek coal is the stationary process in which the coal is brought on shore by pumping or buckets and prepared there. This method is used on creeks that are too small to float barges. In this method the operator depends on coal that the stream brings to the plant since he is unable to move around hunting for the coal bars. This method is a little cheaper than the barge method and permits the use of cleaning devices such as concentrating tables. Dirtier coal may be utilized than in the barge method.

On Shamokin Creek 8 or 9 outfits are working, of which six use a drag or clam shell bucket to bring the coal on shore. The coal is of barley and No. 4 buckwheat size with a very small percentage of domestic sizes. All of the No. 4 is tabled and at most plants the barley is also tabled, but at several plants the barley is cleaned merely by washing.

On Mahanoy Creek the coal is pumped into the stationary plants. The pump is usually located on shore, with a flexible intake pipe extending out into the stream. Tables are used in five of the six plants on this stream.

Several rather small operations on Wiconisco Creek also use the stationary method, but the coal is not tabled, only rewashed. On Swatara Creek an operation at Trout Run uses the stationary method, mounting a pump on a barge and carrying the pipe line on pontoons to shore where the coal is run over tables and shipped by railroad. Farther down the river the coal is boated into the landing and either tabled there or, in one case, loaded directly onto trucks or storage piles. Tables on the lower Swatara are a relatively new thing, the first having been installed in 1929. Up to this time, however, the operators have been working in the coal bars which have been accumulating for the last 40 or 50 years, and are composed of excellent coal, perhaps better than any now being dredged from the creeks and rivers. As soon as these deposits are worked over, concentrating tables will be increasingly necessary.

On the Schuylkill most of the plants are stationary and most of the coal is cleaned on concentrating tables. Two plants near Reading already mentioned and one operation at Hamburg are exceptions. At Hamburg the coal is dredged from behind the old canal dams and boated down to Hamburg on the canal, where it is washed but not tabled. On the Schuylkill it is customary to place the pump on a barge in the river and to pump the coal through a flexible pipe to the tables on shore. The proportion of domestic sizes on this river is very small, and only one operator makes any amount of large sized coal. The commercial sizes are barley and No. 4 buckwheat, which must be tabled to clean them of slate and pebbles.

This stationary method of reclaiming coal with tables has the advantage of furnishing a place from which coal can be loaded into cars or trucks directly from the tables without a second handling and without having to run barges and tugs, but has the disadvantage of being somewhat slower than the barge method because a table can handle only about 10 tons an hour at maximum and if the coal is quite dirty or must be reduced to a low ash content the capacity is much less. Another disadvantage is that the plant is dependent on the coal that the stream brings to it, because the old beds within reach are soon cleaned out. This system, however, is used almost exclusively on small rivers or creeks because it enables the operator to work when the stream is high enough to bring down coal, but not high enough to float loaded flatboats.

Choice of methods. The factors governing the choice of methods for reclaiming coal are five: 1. The size of the stream, which will largely determine whether a stationary or barge outfit is to be used. 2. The quantity of coal, which will determine whether a pump or (in stationary outfits) a bucket is to be used. 3. The size of the coal which will determine the market and to some extent the method of cleaning. 4. The quality of the coal desired, which will determine whether tables or screens, and what kind of screens, must be used. 5. The shipping facilities available, which will determine the arrangement of the plant and the limit of cost of preparation in order that the delivered price may be under the delivered price of fresh mined coal.

Whatever method of cleaning and preparing the coal may be used, there is a certain limit of size below which it is uneconomical to clean the coal. In the case of the screen process of cleaning there is also a physical limit, because in order to screen out the sand the coal must be slightly larger than the sand; and when the coal is fine as the sand, it is no longer possible to make the separation by screening. However, this limit is so very fine that it is not reached in practice, because it would take too long to clean coal of the very finest size.

The smallest that is produced at present with screens is made over a 32-mesh screen. Trying to clean coal any finer than this seems to raise the cost of production too high and a good many operators find even this size too expensive to clean.

In the table method of cleaning, there seems to be no actual physical limit, but as the size becomes smaller the coal must be run slower and slower over the table to ensure satisfactory cleaning, and the cost of cleaning increases until it becomes prohibitive. At present the finest size cleaned is No. 4 buckwheat with a considerable percentage of undersize. Perhaps if the price of fine coal goes up, even finer sizes down to dust will be cleaned.

Marketing.

Use. The great problem in the production of river coal, especially on a large scale, is marketing at a price that will enable the operators to obtain a fair return on their investment. When

river coal was first produced, the sizes were so large that the coal could be burned in the ordinary domestic furnaces and a great part of it was thus used. As years went on, the quantity of domestic sizes dwindled, and the steam sizes became the most important. Thus the greatest part of the output was burned by large industrial and commercial users who had special equipment, such as automatic stokers and blowers to burn these fine sizes. In not a few homes, especially in the vicinity of Harrisburg, blowers were installed to burn fine coal, but the quantity of river coal so used is relatively unimportant. About 25 years ago the power companies in the vicinity of Harrisburg started to burn the river coal and this use has increased from year to year, until fully to-thirds of the coal dredged on the river between Clarks Ferry and Pequea is used for power and perhaps one-quarter of the coal dredged elsewhere is so used. This cheap coal has kept the cost of power in Harrisburg fairly low for a good many years.

At the present time it seems that 90 to 95 per cent of the coal dredged from the rivers and creeks is used about equally for power and industrial purposes.

When used for power purposes very little of the coal is shipped more than 20 miles, and wherever conditions permit, is delivered at the power plant on the barges. This coal ranges from rice and barley on down to smaller than No. 4 buckwheat in size. River coal for power and industrial use is burned for the most part on chain grate stokers of the Coxe type. This type of stoker, for most efficient operation, requires coal not more than 15 or 20 per cent of which will pass through a 1/16 inch screen. If the coal is finer it is difficult to secure complete combustion without a draft so strong that it blows the fine coal up the chimney unburned. By making a very high rear arch in the furnace and a careful adjustment of the drafts in the various tuyeres, coal even as fine as No. 4 buckwheat can be burned with more or less success. A mixture of barley and No. 4 buckwheat leaves spots of fine material which cause blowholes and high stack loss. For this reason, and also because of the expense of altering their furnaces for burning fine coal, most plants try to get coal not more than 20 per cent of which passes through a 16-mesh screen.

As the river coal gets finer and finer, however, it becomes harder and harder to find coal of size sufficiently large to burn efficiently in ordinary Coxe stoker furnaces. The only solution seems to be to pulverize the coal and burn it in specially built plants. Three power plants at present are burning pulverized river coal; the Pine Grove plant of the Pennsylvania Power & Light Co. the Middletown plant of the Metropolitan Edison Co., and the Holtwood plant of the Pennsylvania Water & Power Co.

The Pine Grove plant burns about 25,000 tons a year of both barley and fine coal, the barley being burned in Coxe stokers and No. 4 buckwheat in pulverized form. Very good results with this coal are reported and an ample supply seems to be furnished by the river coal operators on the upper Schuylkill. The Middletown plant burns river coal during only five months of the year, and that mixed with bituminous slack in proportions varying from 30 to 70 per cent. The rest of the year the supply of river coal is inadequate and bituminous coal alone is burned. Very good results from the river coal are

reported, but sand in it, amounting to 5 to 10 per cent, increases the wear on the pulverizers and, together with the hardness of the coal, cuts the capacity of the mills almost in half as compared with bituminous coal. Only about 1,500 tons of river coal a year are used here out of a total of about 70,000 tons, so that the wear on the pulverizers is not such a large item as it would be if river coal were used entirely.

At the Hillwood plant, the coal-burning power station uses about 70,000 tons a year of river coal pulverizes and mixed with about 25 per cent of bituminous coal. Excellent results are reported. The river coal used here is dredged in the vicinity of Pequea and contains 8 to 10 per cent sand but the wear this causes on the pulverizers is to some extent offset by the fine size of the coal as received, 85 to 90 per cent of which will pass through a 1/16 inch round hole screen.

The advantage of pulverizing the river coal is that any size of material down to very fine dust may be used, but the drawback is that the material must be quite free of sand, and it is, as has been shown before, extremely difficult to separate the sand from the small sizes of coal at a reasonable cost. Thus, while most companies using this pulverized coal would like to have the sand content of the coal reduced to 3 to 5 per cent, they find that they have to be content with a sand content of 8 to 10 per cent or pay a price for the river coal which makes its use uneconomical.

Another method of burning the river coal is by hand firing or pinhole grates using blowers. On account of the labor item this method is used in very few large plants, the most notable being the Central Iron and Steel Co. at Harrisburg which formerly burned some 70,000 tons a year, but has since cut this consumption one-third by using waste furnace gases. In most cases, however, the use of this method is confined to small domestic furnaces. For burning in this way, the coal does not have to be particularly clean and the undersize usually burns quite well although the very finest dust will drop through the grate.

Although almost all the river coal is burned for steam, about 15,000 or 20,000 tons a year are used for recarbonizing steel in the open hearth process. The coal used for this purpose must be especially washed before using, as any sand in the coal would form iron silicate and render the steel brittle. For some reason, as yet undetermined, river coal gives better results when used in this process than any other kind of anthracite, having none of the fresh mined coal's tendency to make the steel cold short. Thus, in this field, river coal has no competition and will be used as long as it does not get too fine to clean properly, because, in this case, the cost of the recarbonizing agent is less important than its quality.

The location of the markets for river coal varies with the type of coal and the manner of recovery. Most of the barley coal recovered from Shamokin and Mahanoy creeks and Schuylkill River is sold in Philadelphia, Wilmington, and Baltimore where a number of industrial and commercial plants use upwards of 200,000 tons a year. The No. 4 grade from these creeks goes to Pine Grove, Philadelphia, Wilmington or Baltimore for use as fuel, or to steel plants in

re
Pennsylvania and Maryland for use as a/carbonizing agent. Some of the barley grade from these creeks goes to the Armstrong Cork Company at Lancaster. The small quantity of buckwheat and larger sizes produced is burned locally. On the Schuylkill, the silk and hosiery mills from Schuylkill Haven to Reading burn a sizable part of the output of barley coal. A small proportion is used for heating office buildings in Reading. About 2,300 tons a year is used by the gas companies at Reading and Hamburg.

On the Swatara, the only plant shipping river coal by rail is at Trout Run where No. 4 buckwheat is being shipped on the Pennsylvania Railroad to the Bethlehem Steel Company at Lebanon. Barley coal from this plant is trucked into Lebanon and burned there by various industrial plants, and in some domestic furnaces. Almost all the coal recovered by the five operators farther down the creek is trucked into Harrisburg to be burned in power plants.

As river coal is in such sharp competition with fine-sized, freshly mined coal in all fields except that of recarbonization, it follows that the location of the markets for a particular plant whose product must be shipped by rail depends largely on freight rates as well as on cost of production. It is obvious that an operator cannot market his coal where the freight rate on fine sized coal from the mines is enough lower than the freight rate from the river coal plant to offset the lower production cost of the river coal. The freight is usually the largest cost in marketing. In the Schuylkill Haven District the price for barley coal ranges from 60 to 80 cents a ton, and for No. 4 buckwheat ranges from 40 to 50 cents. The freight rate to Philadelphia on this coal is something over $ 2.00 and if the coal is handled through a broker his fee must be added, and also unloading and any demurrage charges, so that the delivered price of river barley in Philadelphia is around $ 3.00. Add to this the increased cost per pound of steam due to the higher ash content and the lack of uniformity of the river coal and it will be found that fresh mined arthracite and coke breeze come in very close competition. Thus it will be seen why Baltimore and Philadelphia are the most distant points to which any quantity of river coal can be shipped for use as fuel. The small margin of profit on which a river coal operator works and the great influence of the freight rates and the location of the market are shown by the fact that although most of the plants shipping from the Schuylkill River are on the Philadelphia & Reading Railroad and ship the No. 4 buckwheat to Pine Grove, one operator at Auburn on the Pennsylvania Railroad finds that the transfer charges from the Pennsylvania Railroad to the Philadelphia and Reading would eat up his profit and that he can better afford to ship his fine coal to Wilmington, twice as far away.

On the Susquehanna the cost of dredging by the barge method would, for the most part, raise the delivered price of coal to a prohibitive level if it were shipped by rail. In addition, the location of large industries and power plants, together with numerous smaller establishments on or near the river, renders rail shipment unnecessary. Only in the vicinity of Sunbury does there seem to be a lack of a local market; between Klines Grove Station (on the North Branch about 4 miles above Sunbury) and Sunbury there are two operators shipping to Lancaster and Philadelphia. These are the exception, rather than the rule, however.

The coarse sizes of coal dredged at Plymouth below Wilkes Barre are burned at a fertilizer plant near by and the steam sizes go to the Hunlock's Creek power station. This output only amounts to 1,800 or 1,900 tons a year.

The next dredging operations are in the vicinity of Bloomsburg, mostly at Almedia and Espy. The production here is 80,000 to 90,000 tons a year, of which the State Teachers College and various greenhouses at Bloomsburg have been the largest users, the Magee Carpet Company and the Bloomsburg Heating Works coming next. The price of good barley coal is about $ 1.00 a ton on the flatboat. The sizes from buckwheat to rice go for heating in domestic furnaces, the price being from $ 2.00 to $ 3.00 a ton. The river coal is rather important in this vicinity as a domestic fuel and some people dig their own winter fuel with hand sieves at low water.

The next extensive dredging operations are at Danville. All of the coal dredged here is used locally, most of it in silk mills the State Hospital, and borough water works. This coal is all hand fired in furnaces equipped with blowers. It brings about $ 2.50 a ton delivered and probably $ 1.50 to $ 2.00 a ton on the boats. It is a mixture of rice and barley. The coarser coal is burned in domestic furnaces, mostly without artificial draft. The total production in this vicinity is 10,000 to 12,000 tons a year.

One operator at Danville, with a view of providing a steady domestic market for his output of fine sizes, is using a scheme worthy of mention in connection with the marketing of river coal. He sells blowers and pinhole grates for domestic furnaces that enable the householder to burn sizes down to No 4 buckwheat. These blowers and grates are sold at cost under a 5-year lease agreement, the operator contracting to furnish all the coal needed for that furnace for 5 years at $ 7.50 a ton. Thus a steady known market is assured for the fine coal and the profit from the sale of coal is calculated to make up for lack of profit in the blowers. This operator has installed a concentrating table so that even dirty coal may be dredged, and the coal recovered in profitable quantities for at least the 5 years of the contract. The scheme has been in operation only about two years in this vicinity, and it is too early to predict its success.

Except for the two operators before mentioned no coal from the vicinity of Sunbury is shipped by rail. The only large users of fine sized coal are the water company at Sunbury, a small silk mill at Port Treverton, and the Northumberland public schools. The dye works takes only a few cars a year. Most of these operators in this part of the river have small outfits and have depended in the past largely upon the domestic market. As the size of river coal has decreased this market has almost disappeared and in industrial plants electricity is displacing steam so that there is little market for the fine coal, especially since the Milton power plant has stopped buying river coal. For barley and rice coal the price is about 40 cents to $ 1.00, and domestic sized coal brings about $ 2.00. The total production of this district is about 12,000 tons a year.

From Port Treverton to Clarks Ferry there is only one small operation, supplying coal for a silk mill at Liverpool. From Clarks

Ferry to the limit of dredging at Pequea the operations are quite large, most operators having at least two or three dredges and two or three men having 20 or 25, together with a fleet of trucks.

Vicinity of Harrisburg. The coal dredged from Clarks Ferry to Middletown is sold in Harrisburg and vicinity. In the past a notable quantity was burned in domestic furnaces with special stokers and blowers. The increasing fineness of the coal and the reluctance of the bigger operators to handle small orders when the power companies stood ready to pay cash for their entire output, has diminished the importance of this market until now one or two of the small operators supply almost all of the domestic demand. In the past the river coal was used for heating a good many of the larger buildings in Harrisburg, including the Capitol, but the difficulty of burning the fine sizes has led them all to the use of fresh mined coal or steam bought from the Pennsylvania Power and Light Company's central steam plant which, however, does burn the river coal. It should be borne in mind that the loss of fine coal up the stack is more serious in a city than in thinly settled territory as the coal dust settles on all the buildings and becomes very objectionable to neighboring tenants as well as the occupants of the building itself.

The only large consumers of river coal in the vicinity of Harrisburg are the Pennsylvania Power & Light Company, the Metropolitan Edison Company, and the Central Iron & Steel Company. Between them they use nearly the whole production of about 250,000 tons a year together with a few thousand tons from the Swatara in the vicinity of Hummelstown. The Harrisburg Railways burned river coal exclusively in their power plant until April 1920 when they went over to fresh mined coal except for a small quantity of very good quality creek coal trucked from Hummelstown. They report that the coal was getting too fine to burn efficiently on Coxe stokers. The Pennsylvania Power & Light Company report rather good results in burning fine coal on Coxe stokers with high arch furnaces, but at present are trying to get the river operators to reduce the proportion of sand in their coal to 2 or 3 per cent. The Metropolitan Edison Company at the Middletown plant burns river coal in pulverized form. The price of fine size coal delivered at the company plant in the vicinity of Harrisburg is $ 1.50 to $ 2.50 a ton, although the price is not stable.

From Middletown south there are four operators, working at Cly, Marietta, Columbia, and Pequea. At Cly, coal from rice to No. 4 buckwheat in size is dredged from behind the power company's dam. The No. 4 goes to the paper mill at York Haven and the barley and rice are sold for use in domestic furnaces equipped with blowers. The operators at Marietta and Columbia also sell largely to domestic users in the vicinity, although the water company at Columbia takes about 1,100 tons of barley coal a year. The total output going to domestic use probably does not exceed 7,000 tons a year at an average price of $ 2.50.

It should be said that the operator at Columbia is using, and seems to be the originator of, the scheme of selling domestic furnace blowers with a contract to furnish coal for 5 years. He cleans his coal on a table but even so finds it hard to get barley coal. He reports fair success with his plan.

The coal dredged in the vicinity of Pequea all goes to the Holtwood power plant where it is pulverized, as has been mentioned above. The total output is in the neighborhood of 60,000 to 70,000 tons a year.

The coal dredged out of Wiconisco Creek is all used in the vicinity, excepting a very small amount shipped out through brokers. It is of barley size and is burned either in domestic furnaces or sold to Johnson-Baillie Shoe Company at Millersburg. At Millersburg the Pennsylvania Power & Light Company operates two dredging outfits which supply the 24,000 tons of coal burned annually at the Millersburg station. This coal is very fine and the stack loss is high, but the low cost of the coal offsets the lost efficiency. The total output of Wiconisco Creek does not exceed 35,000 tons a year.

Thus it is seen that one-third to one-half of the river coal produced is not shipped more than a few miles and a good bit of it is unloaded directly at the consumers plant. When the coal is shipped it is usually from a stationary plant to some place within approximately 200 miles. During strikes or suspensions in the anthracite fields river coal is shipped much farther, even to New England. Some very fine coal was once shipped to a briquetting plant at Duluth. In normal times, however, 200 or 250 miles seems to be the most transportation that river coal will stand without wiping out its cost advantage over fresh mined coal. This rule does not apply to river coal used for metallurgical purposes as there it has an advantage over fresh mined coal which does not depend on price.

Future.

The future of the river coal industry is of great interest and importance, not only to the producers and consumers of river coal, but to the residents of the towns along the rivers where industries have had access to this source of cheap fuel for the last 20 or 30 years. Any prediction as to the future of the industry must be subject to error for it should be based on a consideration of several factors, any of which may very greatly in the next few years. These factors are:

The quantity and size of coal finding its way into the streams.

The future development of combustion apparatus for the utilization of the very fine sizes of coal.

The future improvement in production and marketing of the fine sizes of river coal.

The trend in fresh mined steam size coal prices in the next few years.

The cost of transportation in the future.

As to the first factor - the material going into the streams; so long as coal is mined probably some coal of value will go into the streams, although its amount will very gradually decrease.

So long as culm and silt banks are left unprotected some coal will be washed into the rivers, but as these banks are loaded or protected, this source also will gradually diminish. On the other hand, as the streams are relieved of their burden of silt from these sources, they will begin to cut into the accumulations of silt contained in their flood plains and bring down coal from this source. This process may be hastened by the river coal operators, at least one of whom plans to put a pump on the Shamokin or Mahanoy creeks flood plains and pump the coal to his plants downstream. Thus it will be seen that there will be a gradually diminishing, but still considerable, amount of coal coming down the streams for 15 or 20 years. In 5 or 6 years the barley coal probably will be very hard to get below the mouth of the creeks.

As the quantity of river coal of barley and larger size decreases, and No. 4 buckwheat and smaller size increases, the continued dredging of the coal must depend on a greater development in methods of utilizing fine sizes. The present writer's knowledge of combustion apparatus is too meager to enable him to make a prediction as to future developments in burning fine size anthracite. While high rear arches in furnaces may make it possible to burn much finer coal on chain grate stokers than has heretofore been the practice, it seems that, to utilize the very fine sizes, pulverization must be employed and it is probable that this method will be increasingly used in the next 10 years, especially on the lower part of the Susquehanna where the increasing fineness of the coal is felt first.

As to the next consideration, great improvements in the production and marketing arrangements are possible. As the coal becomes finer in size and smaller in amount, there will be an increasing use of concentrating tables, hydrotators, flotation boxes and similar devices to clean the fine coal sufficiently to use with pulverized coal burning equipment. This will increase the investment in cleaning equipment so that few of the smaller operators will be able to survive. The next 10 years will see an increasing trend to larger and fewer operations. This will, in turn, improve the marketing structure of the industry, for the operators will be able to deliver larger quantities of coal of uniform quality and by taking a smaller profit on each ton will be able to keep the price down to a point which will insure a much more steady market then the small operator can count on. As the coal gets finer the distance to which it will be profitable to ship the coal will decrease and the market will narrow to that of the power companies and a few industrial concerns not too far from the rivers. This, of course, does not apply to the coal used for recarbonization where the cost of transportation is not so great a factor as the quality of the product. Coal for this use probably will continue to hold its present market.

The future of the river coal industry is inextricably bound up with the future of the anthracite industry, in that the price of fresh mined coal decides where and how much of the river coal can be sold. Obviously, if the price of fresh mined fine sized coal is high, the river coal can be shipped farther and sold to more people than if the price of fresh mined coal is so low that the difference in price between fresh mined and river coal is not enough to make up for the higher ash content and fine size of the river coal. What the trend of fresh mined coal prices will be in the next 10 years is hard to predict, but it seems likely that, as the demand for the cheap steam

sizes becomes greater and the profitable domestic sizes have a smaller sale, the mine operators will be forced to raise the price of the steam sizes or operate at a loss, which would eventually mean the closing down of the collieries. If, or when, this price rise takes place, it will mean a new opportunity for the river coal operators, who will find that they are able to sell to a great many customers who had previously found fresh mined coal cheaper per pound of steam than river coal. This change in price of fresh mined steam sizes may not be forced for several years, however, and the river coal until then must meet increasingly heavy competition from fresh mined fine coal.

Perhaps one of the greatest factors in the future marketing of river coal is the freight rates. While it is impossible to tell definitely what adjustments the next few years will bring in the rates on coal, it seems reasonable to suppose that any revision made in the next few years will be in a downward direction, as the condition of the anthracite market is such that any increase in freight rates or even, in some cases, the continuance of the present rates would cut considerably the sales and thus the shipments of coal by rail. Therefore it seems that the river coal may gain reduced freight rates in the next few years and this will tend to broaden the market, although the fresh mined coal will share the same advantage.

Thus it is seen that, while the source of the river coal is gradually getting smaller and the coal is getting finer and worse in quality, there are other factors working to improve the condition of the industry, such as new developments in utilization of fine coal, and probable increase in price of fresh mined coal and reduction of freight rates. Therefore, it would seem that in the next 5 years the production of river coal will remain about stationary. The number of operators will decrease, the smaller ones being forced out while the larger ones will install improved machinery for recovering and preparing the fine sizes, and will make their money by taking a small percentage of profit on a large tonnage of fine sizes. Probably, toward the end of this period, the production will begin to decline, although a few of the larger operators will continue to take very fine coal out of the river in large quantities for 20 years longer. Eventually, however, even large operators will combine coal dredging with sand dredging, as several small operators on the lower Susquehanna are doing at present. There can be little doubt that there will be some coal in the streams as long as there is coal mined in the anthracite regions, although its size will be very fine.

Statistics of Production.

The following tables were furnished by the Pennsylvania Department of Internal Affairs, Bureau of Statistics, and show development of the industry for the last five years. For statistics of earlier years, the reader is referred to "Anthracite Culm and Silt," pp. 178-181.

Coal reclaimed from streams.

1927

Counties	No. of establishments	Total number of employes	Total wages and salaries	Capital invested	Amount produced Tons	Value of production
Berks	3	15	$ 34,100	$ 76,300	24,336	$ 41,300
Dauphin	12	244	251,100	382,400	319,869	345,500
Lancaster	2	28	32,800	109,000	70,053	75,700
Lebanon	1	5	4,000	20,000	7,139	6,100
Montour	1	1	400	4,000	900	1,500
Northampton	1	8	9,200	3,600	29,410	31,800
Northumberland	9	71	95,100	331,800	190,628	203,000
Schuylkill	2	9	14,900	17,500	50,775	55,400
York	1	20	22,000	36,000	37,234	35,000
Total	35	411	$463,600	$ 983,100	740,345	$ 794,700

1928

Berks	3	13	$ 28,000	$ 76,900	17,586	$ 37,900
Columbia	6	15	7,400	45,000	14,365	18,500
Dauphin	13	238	235,700	449,500	237,371	298,800
Lancaster	3	45	50,000	114,500	63,603	63,100
Lebanon	1	5	4,300	22,000	13,286	12,400
Luzerne	1	6	7,800	13,500	20,038	17,800
Montour	2	2	1,700	7,000	1,900	4,000
Northampton	1	7	9,100	10,000	28,814	44,400
Northumberland	8	74	128,600	310,000	219,819	203,900
Schuylkill	9	37	49,000	111,900	114,084	90,700
York	1	19	20,400	37,500	23,205	26,700
Total	48	472	543,100	$1,304,000	754,054	$ 815,000

1929

Berks	3	23	$ 25,500	$ 75,400	21,820	$ 34,300
Columbia	3	16	8,800	45,200	15,153	19,100
Dauphin	17	239	239,100	625,400	263,064	340,700
Lancaster	2	28	24,200	14,500	38,264	31,900
Lebanon	1	3	3,900	20,000	11,478	11,400
Montour	2	2	1,400	7,000	1,950	3,900
Northampton	1	8	8,500	10,000	24,472	37,700
Northumberland	8	49	63,900	338,500	93,289	99,300
Schuylkill	9	40	40,500	159,800	100,468	83,500
York	1	18	20,400	39,600	23,615	28,300
Total	50	426	$ 436,000	$1,303,400	593,490	$ 680,100

River Coal Operators

Operator	Location	Works
Alleman, Grant E. (Drifted Coal & Supply Co.)	Shoemakersville	Shoemakersville
Ashton, Warren & Hoffman, Leo	Espy	Espy
Bickel, N. S.	R. D. 1, Port Trevorton	Independence
Blue Mountain Coal Co	Hamburg	Hamburg
Bowen & Fisher	Orwigsburg	
Creek Forks Coal Co.	Trevorton	Hunter
Couffer, R. D.	Wormleysburg	Highspire
Custer, C. E.	Almedia	Almedia
Davis, C. C.	402 Bridge St., New Cumberland	Harrisburg
Downey, F. H.	1369 S. Cameron St., Harrisburg	Harrisburg
Drifted Anthracite Coal Co.	Shoemakersville	Bowmanstown
Ebersole, John M.	P. O. Box 388, Reading	West Leesport, Tuckerton
Ebony Coal Co.	619 E. Dewart St., Shamokin	Shamokin
Economy Coal Co.	Box 1102, Harrisburg	Schuylkill Haven
Emrick, R. J.	R. 2, Annville	Harpers
Fisher, C. Arthur	Orwigsburg	Gordon, Barry Sta.
Fordham Co., B. W.	Trevorton	Mahanoy Creek
Forney, Alfred Coal Co.	Danville	Riverside
Forney, C. E.	Danville	Riverside
Forney, Clarence	Danville	Danville
Forney, Mark	Danville	Danville
Fox, Fred R.	719 W. 10th St., Bloomsburg	Bloomsburg
Fox, George	Schuylkill Haven	Schuylkill Haven
Frymire, A. J.	Shamokin Dam	Sunbury
General Dredging Co.	Bloomsburg	Espy
Gordon Co.	420 Lexington Ave., New York, N. Y.	Gordon
Gulliver & Price	Espy	Espy
Hartman, George & Hoover, T.	Shamokin Dam	Sunbury
Heas, Luther	Espy	Espy
Herrold, C. S.	Port Trevorton	Port Trevorton
Holstein Brothers	Schuylkill Haven	Schuylkill Haven
Hoover, Jesse	Almedia	Almedia
Hoover, Richard	Almedia	Almedia
Hottenstein, Harvey	Shamokin Dam	Sunbury
Householder & Stewart	1639 Susquehanna St., Harrisburg	Hummelstown
Huff, Wm. H.	New Cumberland	Highspire
Industrial Coal Co.	402 Bridge St., New Cumberland	Harrisburg

Jonathan Coal Mining Co.	Phila. Natl. Bank Bldg. Philadelphia	Snydertown, Deiblers Kulps, Arters, Reed Paxinos, Hunter, Dornsife, Herndon
Keller, Irwin	Hummelstown	Hummelstown
Klines Grove Coal Co.	604 Colonial Trust Bldg., Reading	Klines Grove
Landingville Coal Co.	Landingville	Landingville
Lehigh River Steam Coal Co.	604 Colonial Trust Bldg., Reading	Treichlers, Mauch Chunk
Lukens, H. V.	R. D. 4, Duncannon	Clarks Ferry
McCreath, Robert	565 Race St., Harrisburg	Harrisburg
McCready, Kraut & Co.	York Haven	Cly
Manbeck Coal & Ice Co.	Schuylkill Haven	Schuylkill Haven
Marietta Coal Co.	Marietta	Marietta
Martin Const. & Supply Co.	135-45 N. 10th St., Harrisburg	Harrisburg
Masters, H. J.	Sunbury Water Co., Sunbury	Sunbury, Klines Grove
Mengel, Uriah H.	Auburn	Auburn
Miller Bros.	8 Cooper St., Danville	Danville
Moore, W. F.	Northumberland	Northumberland
Penna. Power & Light Co.	Allentown	Millersburg
Pequea Fuel Co.	304 N. 2nd St., Harrisburg	Safe Harbor
Reber Coal Co., A. C.	Palmyra	Harpers
Schafer, Eugene	15 W. Liberty St., Schuylkill Haven	Schuylkill Haven
Schoner, Wm.	Adamsdale	Auburn
Schuylkill Haven Drifted Coal Co.	604 Colonial Trust Bldg., Reading	Schuylkill Haven
Sears, Raymond	127 W. Mahoning St., Danville	Danville
Seebold, C. C.	Riverside	Riverside
Sensennick, Est. of amos R.	Harry Sensennick, ex. Lititz	Trout Run
Shissler, Ed	Camp Hill	Lemoyne
Sickler Fertilizer Co.	Plymouth	Plymouth
Sneidman Brothers	Almedia	Almedia
Snyder, J. W.	Orange St., Northumberland	Northumberland
Sommons, Benjamin	Danville	Danville
Steffen, F. F.	Riverside	Riverside
Stewart, M. B.	West Fairview	West Fairview Clarks Ferry
Stewart, Ray E.	833 Paxton St., Harrisburg	Harrisburg Clarks Ferry
Stroh Brothers	346 Hamilton St., Harrisburg	Harrisburg
Sturtevant Coal Co., N. L.	Elizabethville	Elizabethville
Susquehanna Dredging Co.	407 Walnut St., Columbia	Columbia
Treichler Drifted Coal Co.	Shoemakersville	Treichlers

Wilkinson, I. U.	Trevorton	Mahanoy Creek
Witman, W. S.	Port Trevorton	Port Trevorton
Zeigler Coal Co., F. A.	Elizabethville	Elizabethville
Zerfoss, Charles	Hummelstown	Hummelstown